White Paper

Report ID: 109354

Application Number: HD-51753-13

Project Director: Fred Limp

Institution: University of Arkansas, Fayetteville

Reporting Period: 8/1/2013-12/31/2015

Report Due: 3/31/2016

Date Submitted: 3/30/2016

White Paper - March 2015

Project Title: 21st c. Data, 21st c. Publications: 3D models and building the peer reviewer Community.

Grant Award Number HD-51753-13

PIs: Fred Limp, David Frederick, Rachel Opitz

Awardee Institution: University of Arkansas (Fayetteville)

Date Report Submitted: March 30, 2016

Project Activities

The 21st c. Data, 21st c. Publications: 3D models and building the peer reviewer Community Project, colloquially referred to as the Gabii Goes Digital (GGD) Project, grew out of the Gabii Project, the large scale excavation and study of a town that was a rival of, and then eclipsed by, Rome. At the Gabii Project, we began using 3D models to document the sites stratigraphy, the excavated soil deposits, holes dug into the ground, and structural remains like walls and floors from the beginning of the project in 2009. We were convinced that these models were essential to our own process of interpreting the site and understanding what took place there in the past. Because we say the 3D record as fundamental to our own reasoning, we wanted to include them in our publications, not simply as illustrations, but as a central part of the record. The GGD Project began with the ambition both to make these models a core part of our publication record and promote their acceptance as basic data within the archaeological community. We believed that developing a publication process which would allow the 3D modeling content to be peer reviewed would be essential for its acceptance within the community of archaeological researchers.

The peer review process is designed to help authors strengthen their argument and clarify its presentation. As researchers and academics, we're trained to recognize good and bad writing, and to identify holes and weaknesses in a argument. We learn what makes a useful chart or illustration. There are conventions for the scaling of axes, selection of symbols, and amount of information presented. As reviewers we provide feedback on both the substance and style of a publication, commenting on the text and illustrations and how they work together. But what does good, useful interactive 3D content look like? What are the qualities on which this content should be assessed? The GGD Project worked to address these questions through a pilot publication which integrates 3D modeling content, data, and narrative text. This publication was workshopped with peers, and developed in consultation with colleagues at Michigan Publishing, and their support and cooperation throughout the project is gratefully acknowledged. By developing this pilot publication in the open, with workshops of early drafts, and online seminars to discuss the challenges of the publication model, we hoped to provide a model that would be useful for other, similar projects. The results of this process, with the usual deviations from the original plan, have been positive overall. What happened?

Publication Workflow Development

During the GGD Project our workflow for the preparation of the digital publication has developed. While much follows the traditional pattern of study and preparation of text for a print publication, we have integrated the production of the 3D scenes and the digital data into the same process. Our basic steps are: stratigraphic study, phasing, model preparation (retopology and trimming), writing, reconstruction, specialist reports integration, data distillation for info boxes, database cleanup, scene creation, writing and reconstruction revision, scene revision, finalization. Preparing the 3D data for publication is fully integrated into the process of writing and revision. Notably, once the initial 3D scenes are constructed these are made available online to the collective group of authors, and are regularly consulted during writing and during discussion in preparing revisions of the text.

Publication Platform Development

The publication platform for GGD consists of an AMP (Apache MySQL PHP) stack supporting a website, the browser interface for the project's database, and the 3D scenes packaged for web delivery. The publication format consists of three layers of text: the story, an academic synthesis, and a detailed discussion side by side with the interface for the 3D scenes. The 3D scene provides access to distillations of the project's data and links to the database containing the full data for each element.

Technology Stack Changes

Over the course of the project, Unity3D (Unity), our main platform for assembling 3D scenes, underwent a major version change. Unity 5 required updates to our 3D scenes code base, and a change in our approach to textures and materials due to the introduction of physically based shading. Unity 5 supports building for webgl, and we had anticipated this resolving problems with the need for reader-users to install the unity3D webplayer plugin. However, build for webgl for complex content remains unstable. We are therefore currently still building for webplayer, but will replace this component of the publication with its webgl equivalent once reasonable stability is achieved. This replacement should be seamless and invisible from the point of view of the reader-user, and will allow us to support more browsers. Chrome stopped supporting plugins in 2016, and this is the main obstacle to cross-browser deployment using the webplayer.

Through the GGD Project we have developed an entirely new database structure and browser interface to support the open publication of our basic data, linked through the Unity scene. The Gabii Project has used the ARK (LP Archaeology) system to manage its data since 2012. While the ARK code base has seen updates, significant challenges for trowel-to-web workflows remain –notably the requirement for network connectivity in the field-, and the code base has (as is the case with many long running software development projects) become complex and challenging to customize. For this reason, we have developed a new database structure and interface, using the widely supported codeigniter, bootstrap, and jquery libraries. The new interface follows current responsive design principles, allowing us to support more viewing devices. It is hoped that the simplified database structure and code base will support future customization and development more readily, notably API development. The new interface is available at gabii.cast.uark.edu/data.

Early in the GGD Project we developed a simple webGL viewer, SPATIAL, and workflow for displaying individual models or sets of models in browser. The same functionality is now available in the widely used (in the heritage/archaeology community) 3DHOP platform and through PoTree, with better support for compression and multiple level-of-detail loading and rendering. Therefore we have abandoned SPATIAL in favor of using 3DHOP and PoTree.

Pilot Publication Development

In our original conception of GGD the emphasis was on using the mechanism of peer review to get the archaeological community to treat interactive 3D models as significant contributions to scholarship. An early version of our publication format was sent for formal peer review by

Michigan Publishing (The University of Michigan Press). The assessments of the reviewers, included in earlier reports to the NEH, guided further development of our publication platform and the interface for the 3D scenes and data.

In Spring 2016 the first draft of the digital monograph of the Gabii Project was delivered to the University of Michigan. The monograph will now undergo copy editing and is expected to appear in late 2016. The publication is all digital, no print version will be offered. The negotiation of the contract for this publication with the Press raised a number of points relevant to those engaged with the debate over open access. First, the Gabii team, following the trend for federally funded projects, needs to make its basic data available in an open access format. This raises the question: on what side do the 3D models and data fall? In the end we are attempting to straddle the divide, making individual 3D models of stratigraphic units available open access through the database, but including the assembled 3D scenes and their interface within the content that is purchased through the Press. This distinction between the 3D models acting as individual data units and the synthetic 3D scenes, which are interpretive and therefore scholarship, is important because it both provides a root for satisfying both publishers and funding agencies, and because it clarifies the kind of 3D data that acts as a form of scholarship by distinguishing curated scenes from raw 3D data.

Philosophy / Engagement with the theoretical discourse in archaeology

Unexpectedly, an important outcome of the GGD project has been an engagement with the theoretical discourse in archaeology surrounding the new materialism, phenomenology and embodiment, and the development of a series of principles for *the why of 3D* in archaeology. This line of work grew out of the main question from potential reader-users of our content, and discussions of the peer review of the 3D content. Some sub-sets of the archaeological community are focused on metadata, paradata and provenance. Across the board, members of our community asked what the 3D content added beyond what was possible in 2D illustrations, in short about its independent contribution to the body of archaeological knowledge. The key point then, and what qualifies 3D for treatment as integral to a scholarly work, is that is must provide access to insights not readily available through writing or static illustrations. Our contribution here is to focus on interactivity with 3D data and models, and on the role of the user interface – the tools provided – to shape new insights and promote different modes of engagement with the archaeological record. Our work in this area has focused on the exploration of the role of the interface for the digital 3D content, and the impact of interactions in a 3D space on interpretations of past activities and the manner in which the built environment is used to cue behavior. We suggest that GUIs should be employed to contextualize 3D data and models, with their apparent precision and completeness, within the fluid, sometimes messy process of archaeological interpretation, and that their design is an opportunity to provide theoretical

orientation for digital projects. Watterson (2015, p.122)[1] points out in her discussion of visualizations and visual media that "digital archaeology needs to move forward as a discipline and establish a more productive approach to making and consuming [these] images and consider the ways in which they can influence and aid in the creation of new knowledge." We suggest that a well-designed, theoretically-informed GUI (Figs. 1-3) can aid archaeologists toward a more sophisticated engagement with these media. While pursuing this line, we recognize this is an odd position – in order to be considered worthy of assessment within the conventional academic paradigm of peer review, we must do something disruptive with 3D media and data.

Detailed discussion has been published as a Master's Thesis (T. Johnson, University of Arkansas 2015) and a forthcoming article in Open Archaeology (Opitz and Johnson 2016). The build-out of a theoretical position that explicitly addresses the role of interactive 3D data and the design of the interfaces (publication media) through which we engage with them, is an unplanned but important outcome of GGD. We look forward to hearing reactions from the scholarly community to our Open Archaeology article over the coming months.
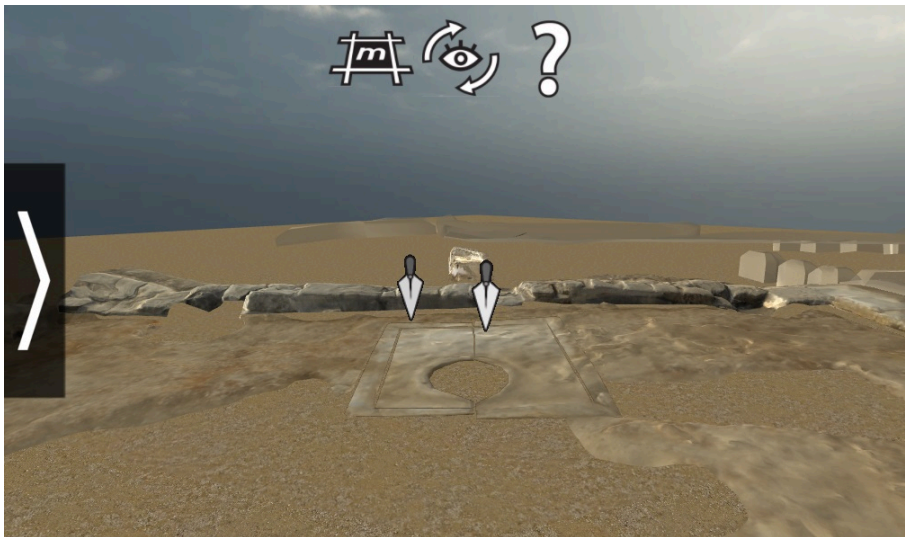

Fig 1: The embodied perspective promoted through interactive 3D.

---

[1] Watterson, A. (2015). Beyond digital dwelling: Re-thinking interpretive visualisation in archaeology. *Open Archaeology*, *1*(1).

Fig. 2: Using the 3D interface to elide synthetic publication and data publication.
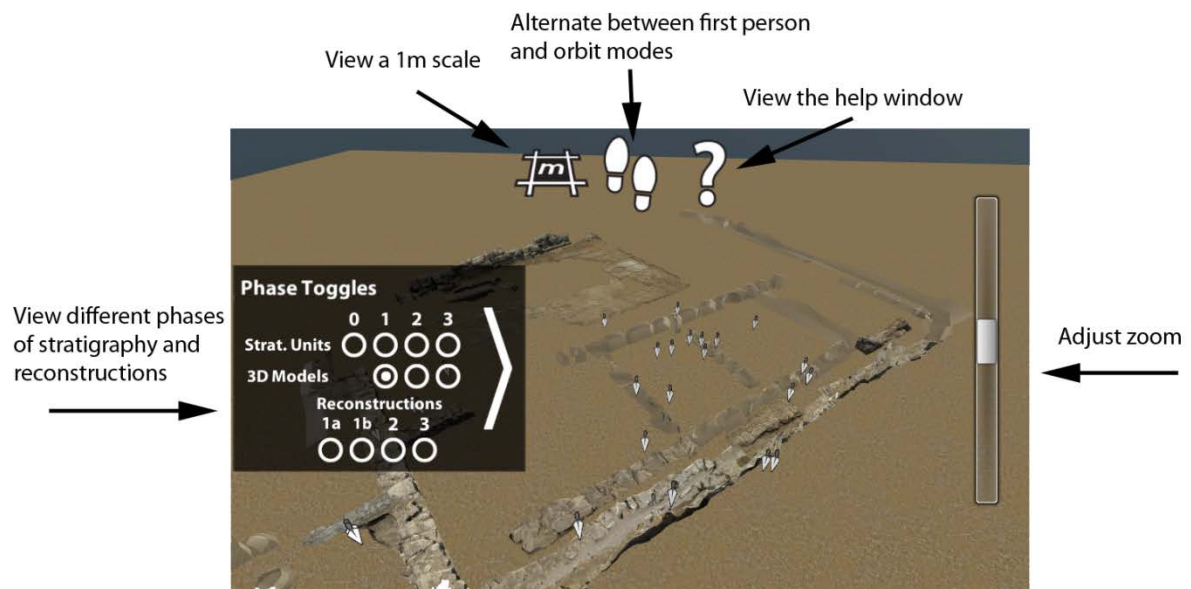

Fig. 3: Interface design that compromises between features of traditional excavation plans (scale, phasing, overhead view) and physicality (colliders on walls, option to explore on foot, enforced natural walking speed).

a. Community Engagement and Audiences

The audience of this project was primarily academic, targeting scholars and researchers in archaeology and related fields. To this end, the project team reached out through online webinars, in-person workshops at conferences, and conference presentations to engage with

the community and promote discussion of 3D models within the peer review process. The project team also began incorporating materials from the project into the curriculum of an honors course taught at the University of Arkansas, to raise awareness of these issues among students.

<u>Products Resulting from this Project:</u>

The Book

Opitz, R., Mogetta, M. and Terrenato, N. (forthcoming, 2017) A mid-Republican House from Gabii. Michigan Publishing.

Websites

Project Website: *http://m-gabii.adsroot.itcs.umich.edu/gabiigoesdigital/*

Pilot Publication Website (Draft):
https://gabii.cast.uark.edu/areab_working/gabii_TincuHouse.html

Articles

Publication: Opitz, R.S. and Johnson, T.J. (2016) Interpretation at the Controller's Edge: Designing Graphical User Interfaces for the Digital Publication of the Excavations at Gabii (Italy). *Open Archaeology,* 2: 1–17.

Theses

 Publication: Johnson, T.J. (2015) Interpretation at the Controller's Edge: The Role of Graphical User Interfaces in Virtual Archaeology. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in Comparative Literature and Cultural Studies, University of Arkansas.

Presentations

Mogetta, M., Opitz, R. and Terrenato, N. (2017, forthcoming) A Mid-Republican House from Gabii and the Formation of Roman Urbanism. AIA 2017.

Opitz, R. (2016) Interface design, working across scales, and a why for 3D in (landscape) archaeology. Modeling Cultures Conference. UCSC. April 1, 2016.

Opitz, R. (2015) Teaching Practice While Developing Practice: Mobile Computing at the Gabii Project Field School. Mobilizing the Past for a Digital Future: the Potential of Digital Archaeology. Boston, MA, 27–28 February 2015.

Opitz, R. (2015) Topographic Survey, Information Visualization, and the construction of archaeological reality. University Nebraska - Lincoln

Opitz, R. and Newhard, J. et al. (2015) Inside-out and Outside-In: Improving and Extending Digital Models for Archaeological Interpretation. Making Meaning from Data (Joint APA/AIA Panel). *Annual Meeting of the AIA and SCS*, New Orleans, January 8-11 2015.

Opitz, R. and Johnson, T. (2014) "Integrated Approaches: Combining SFM and scene-level modeling for data exploration, interpretation and publication of the excavations at Gabii (Italy)." *Space2Place5TH INTERNATIONAL CONFERENCE ON REMOTE SENSING IN ARCHAEOLOGY.* 13-14 October 2014, Duke University, Durham, NC.

Opitz, R. (2014) Topographic Survey, Information Visualization, and the construction of archaeological reality. Theoretical Archaeology Group Conference (TAG), Urbana-Champagne.

Opitz, R. (2013) Reality based surveying, archaeological information visualisation, and the construction of archaeological reality *TAG 2013*, Bournemouth, 16-18 December 2013.

Opitz, R. (2013) Digital Transitions: Technologies for Archaeological Fieldwork, Publishing and Community Engagement. *SAA 78th Annual Meeting, Honolulu, Hawaii, April 3-7, 2013.*

Workshops

Opitz, R., Frisher, B. and Meliconi, I. (2013) *Peer Reviewer Workshop held at the Digital Heritage 2013 Conference*. 28 October - 1 November 2013, Marseille, France.

Webinars

Led by Opitz, R. *Introducing Peer Review and 3D.* GGD Webinar 1, October 14, 2013. *Online.*

Led by Fredrick, D. *GUI Matters.* GGD Webinar 2. March 6, 2014. *Online.*

Opitz, R. Peer review of 3D content/Digital Karnak. January 30, 2015. *Online.*

Project Strengths and Weaknesses

Since the inception of this project a number of journals have begun to publish 3D data as part of their normal online article format. We can cite the recent publication of the Neolithic pendant from Starr Carr in Internet Archaeology as one recent example. The 3D model, published using the 3DHOP viewer (developed by the European project 3DCOFORM), was included as a matter of course. In this sense the question has shifted. It is no longer whether 3D data can be included in peer reviewed research, or can be reviewed as part of a scholarly work, when it serves an analogous purpose to an illustration. Rather, the community has recognized that there are several modes in which this data is being used. There is 3D as archival record, which is discussed in the context of data publication. There is 3D as illustration, typically for objects. There is 3D as reconstruction, long a tradition for architecture. All of these use 3D data within the normal modes of academic discourse. And, perhaps most interesting, there is interactive 3D that is intended to disrupt the normal modes of academic knowledge production and consumption. This is 3D that shades into serious games, data-driven publications, and interactive explorations of data mixed with storytelling. 3D data is now part of a larger debate over the scholarly value of these alternative modes of presenting and publishing the archaeological record and our interpretations of it. Our project did not sufficiently anticipate the speed of change in the field.

Similarly, the speed at which 3D web based technologies was also either over- or under-estimated. We were over-optimistic in the progression of the Unity3D platforms ability to export to webGL, and under-estimated development efforts e.g. 3DHOP within the archaeological community.

Peer Evaluation

While there were a number of obstacles, the project was formally evaluated by Peer Reviewers recruited by Michigan Publishing. These reviewers provided detailed commentary on the merits of the project and the likelihood that a peer reviewed digital monograph incorporating 3D content could be produced by the team. These reviews were favorable, and the submission of said publication has taken place.

Publication Strategy for future Gabii Monographs

The Gabii Project currently has a number of digital monographs planned. These monographs will use the methodology and platform developed through the GGD project. The production of these monographs will involve a number of young researchers and graduate students, and consequently have a broad ongoing impact on their future work and strategies for publication. The team will continue to promote the integration of 3D into the process of scholarly publication, by presenting

the approach developed through this project and conferences. Broadly construed, this pilot project has now become an integral part of the larger Gabii Project, and will continue to be supported within that effort.

<u>Impact on data collection and management strategies</u>

The peer review community has clearly prioritized making data accessible. The GGD project has prompted us to focus on managing our 3D data assets in a way that makes them easily accessible as granular data elements. To this end, we began producing 3D pdfs of individual units, as recommended by the CARARE and 3DICONS projects. The process of making the 3D models integral to our publications also prompted a change in recording strategy. While in the early years of the Gabii project, 3D SFM data capture was only for structural remains and exceptional features, it is now a primary recording method, regularly used for cuts, deposits, and other non-architectural remains. We now model a significantly greater percentage of the sites stratigraphy, and are moving toward capturing all units with SFM. This shift is a direct result of the publication process.

Because we see 3D models as straddling the data publication – synthetic publication divide, depending on how one uses them, the process of bringing the 3D elements of our data to publication have pushed us to bring the rest of the archive to publication as well in order to create a hybrid synthetic-data publication. To improve the data publication workflow overall, the Gabii project switched to tablet based recording in the field in 2014. This was a major adjustment in our on-site workflow. Numerous projects in archaeology have been 'going paperless', and this is a trend that will no doubt continue. The size of the Gabii project made the deployment of this field technology challenging. Both the challenges of scale and the direct link we make between data collection and data publication have made our case an interesting example for our colleagues. To this end, we have participated in workshops e.g. *Mobilizing the Past* and discussions on the subject of mobile technologies and changing fieldwork practice.